Description

Method, communication system and communication device for
transmitting broadcasting information via a communication network.

In current access networks the subscriber access connection designed
5   in accordance with an xDSL data transmission method and providing
high transmission rates is typically in increasingly widespread use.
The broadband Internet access which this makes possible for example
is constantly expanding the number of uses or applications provided
by these access networks. One of these applications is the
10 transmission of information with multimedia content - also referred
to as broadband data streams - such as videos or video streams.
Broadband distribution services, especially multimedia distribution
services (e.g. radio and television) as well as on-demand services
such as "Video-On-Demand" or broadband Internet communication (e.g.
15 video conferences) can be implemented with the aid of these
applications. "Multicast" or "Multicasting" is increasingly being
used to transmit broadband data streams via communication networks.

Multicast or multicasting describes the capability of a
communication network or of the services realized within it to
20 establish connections to a number of connected subscribers or to
send information or messages to a number of previously defined
subscribers (recipients). Within the framework of multicast or
multicasting there is the option of addressing a number of
subscribers via just one address (multicast, group address).

25 In the case of frame or packet-oriented communication networks
multicasting makes it possible to handle the transmission resources
made available by the communication network more efficiently and,

with the appropriately powerful network components or network nodes, to transmit the information to be distributed - also referred to below as broadcasting information - just once from the source towards the subscribers. The network nodes involved in information

5   transmission then independently analyze the incoming data packets and only copy the data at the necessary distribution points to forward it on a number of different connections, so that the data stream only branches at the latest possible points, i.e. close to the subscribers. Within the context of distribution services for

10   example the aim is for n customers, e.g. those requesting or subscribing to the same video stream, to occupy less than n times the bandwidth in the communication network. This is done by transmission of the simple data stream for as long as the network sections needed are identical for a plurality of recipients. Only at

15   the point at which the data is branched out on different transmission links or on different virtual connections is it duplicated or replicated. This type of branching point is represented for example by a remote communication device located locally in a communication network - e.g. a multiplexer, DSLAM - to

20   which the relevant assigned subscribers or subscriber connections are connected via a virtual connection for a specific subscriber connection of an access network in each case and the information for the individual subscribers is transmitted between the subscribers and the communication unit via the virtual connections that have

25   been set up. Normally on the network side the multicast protocol used within the framework of multicasting is terminated in this communication device, i.e. a multicast data stream arriving at this communication device or at least a part of the stream is replicated n times and the replicated data streams are transmitted over the

30   virtual connections specific to individual subscribers in the direction of the subscribers.

This n-times transmission of broadband data streams, especially as a result of the distribution services implemented in subscriber access networks, represents an ineffective use or a waste of the transmission resources provided by the access networks.

5   The underlying object of the invention is thus to improve the implementation of distribution services and in particular to achieve a more efficient utilization of the transmission resources made available by the access networks for broadcasting information transmitted within the framework of a "multicast°. The object is
10   achieved, using a method in accordance with the features of the preamble of Patent Claim 1 as a starting point, by the claim's identifying features. Furthermore the object is achieved, using a communication system and a communication device in accordance with the preambles of Claims 19 and 24, by the respective identifying
15   features of these two claims.

With the method in accordance with the invention broadcasting information routed to a central communication unit is transmitted to subscriber connections connected to at least one decentralized communication unit via at least one communication network. For the
20   transmission of the information to individual subscriber connections, starting from the central communication unit, at least one virtual connection specific to the individual subscriber connection is set up via the communication network, via the decentralized communication unit to/via each subscriber connection
25   in each case. The important aspect of the method in accordance with the invention is that at least one further virtual connection is set up in each case between the central unit and the at least one decentralized communication unit. In the central communication unit the broadcasting information is checked as to whether at least a
30   part of the broadcasting information is to be transmitted to a number of subscriber connections of the at least one decentralized communication unit. The at least one part of the broadcasting information for a number of subscriber connections is transmitted

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via the at least one further virtual connection to the at least one
decentralized communication unit, duplicated in this unit and
forwarded in each case to/via the number of subscriber connections.

The main advantage of the method in accordance with the invention
5 lies in the fact that the branching point or replication point
needed, at which at least a part of the transmitted multicast data
stream or the transmitted broadcasting information is to be
replicated, are shifted further towards the subscribers. This avoids
an n-times transmission of broadband data streams or broadcasting
10 Information via the same communication network so that precious
transmission resources can be saved or the transmission resources
provided can be used efficiently. Advantageously the replication of
the broadcasting information does not have to be undertaken as per
the prior art at one of the network side end points of the virtual
15 connection for the specific subscriber connection usually arranged
in a central communication unit; Instead the information to be
transmitted, provided the physical transmission link is identical,
is transmitted just once in parallel to the virtual connections
specific to the subscribers, via at least one further virtual
20 connection specifically provided for this purpose, to a
decentralized communication unit. The decentralized communication
unit is the end point of this at least one specific virtual
connection - also referred to below as a virtual connection specific
to the communication unit - which is not assigned to any subscriber.
25 The broadcasting information transmitted via this specific virtual
connection is thus identified as broadcasting information to be
replicated, so that expensive monitoring of the information arriving
at the decentralized communication unit can be dispensed with.

In accordance with an advantageous further development of the method
in accordance with the invention different transmission protocols
are implemented by the virtual connections for specific subscriber
connections routed via the at least one decentralized communication

5   unit. For each of the transmission protocols implemented via the at
least one decentralized communication unit at least one further
virtual connection between the central unit and the at least one
decentralized communication unit is set up for the individual
transmission protocol - Claim 6. Advantageously the broadcasting

10   information routed to the central communication unit is checked to
see if this information is to be transmitted to a number of
subscriber connections of the at least one decentralized
communication unit implementing the same transmission protocol. If
it is established that at least a part of the broadcasting

15   information is to be transferred to a number of subscriber
connections implementing the same protocol the at least one part of
the broadcasting information is transmitted from the central
communication unit via the at least one individual virtual
connection for the transmission protocol to the at least one

20   decentralized communication unit, duplicated there and forwarded
to/via the number of subscriber connections implementing the same
transmission protocol - Claim 7. This advantageous further
development of the method in accordance with the invention enables
the subscribers assigned to a decentralized module to be connected

25   by means of different data transmission methods, that is using
differently designed protocol stacks. For each type of protocol
stack implemented in the decentralized communication unit or for
each type of data transmission method implemented an individual
virtual connection i.e. a virtual connection individual to a

30   communication unit and simultaneously to protocol stack is set up
for transmitting the broadcasting information between the at least
one decentralized module and the central module. Thus the method in
accordance with the invention can also be used if subscriber

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connections providing different transmission technologies or virtual
connections designed in accordance with different transmission
protocols are arranged in a decentralized communication unit or
decentralized module.

5   Further advantageous embodiments of the method in accordance with
the invention as well as a communication system and a communication
device for performing the method can be found in the further claims.

The method in accordance with the invention is explained in greater
detail below with reference to a drawing in the form of a block

10   diagram.

The block diagram shows the structure of a network element NE
arranged in a subscriber access network ACCESS - for example of a
remote Digital Subscriber Line Access multiplexer (DSLAM). The
network element NE comprises a central communication unit ZBG

15   designed as a module and a number of decentralized communication
units DBG1...z also designed as modules, with the block diagram only
showing one decentralized communication unit to represent a number
of said units. A control unit STGZ is arranged in the central
communication unit or central module ZBG which comprises control

20   means CONT to execute the method in accordance with the invention as
well as an Ethernet Switch EN-SW designed in accordance with IEEE-
Standard 802.3. Means IGMP for network termination of the IGMP
protocol are also provided in the control unit STGZ. The IGMP
protocol is for example described in the document IGMP V2,RFC2236.

25   The control unit STGZ is connected via an input SE as well as via a
further input ZE assigned to the central module ZBG to a higher-
level communication network OKN. The control unit STG is connected
via one output SA in each case to an access unit AE arranged in the
central module ZBG. The central module ZBG is connected via one of

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the access units AE in each case to a communication network EN -
referred to hereafter as the Ethernet - designed in accordance with
IEEE-Standard 802.3 and provided as internal wiring of the modules
(backplane). The central communication unit ZBG is connected via the

5   internal communication network or Ethernet EN to an input DE of the
individual decentralized modules DBG1...z. The decentralized modules
DBG1...z each feature a control unit STGD which also includes control
means CONT for executing the method in accordance with the invention
as well as an Ethernet Switch EN-SW designed in accordance with IEEE

10 Standard 802.3. The control unit STGD is connected via an input SE
to the input DE of the relevant decentralized modules DBG1...z.
Furthermore the control unit STGD is connected via an output SA to
corresponding subscriber access units AE arranged in the
decentralized modules DBG1...z. A number of subscribers are connected

15 to these subscriber access units AE via trunks or subscriber
connections TLN11...nk in each case. The relevant subscribers
TLN11...nk can be connected to the individual subscriber access units
AE of the decentralized modules DBG1...z for example by means of twin
copper wires over which an xDSL transmission method is implemented

20 in each case.

It is assumed below that a multicast data stream comprising
broadcasting information m_inf is transmitted via the higher-level
communication network OKN to the input SE of the central module ZBG
terminating the multicast protocol. The multicast data stream is for

25 example designed in accordance with the Internet Protocol, with the
transmitted broadcasting information m_inf k representing k
television channels transmitted in parallel.

Furthermore it is assumed that for each subscriber connected to the
subscriber access units AE or via each subscriber connection TLN

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11...nk provided for the purpose a (subscriber-individual) virtual
connection starting from the relevant subscriber is set up via the
decentralized module DBG1...z via the Ethernet EN through to the
control unit STGZ arranged in the central module ZBG. These virtual
5   connections vid_11...nk are also referred to as "Ethernet VLANs" and
are embodied in accordance with IEEE Standards 802.1Q and 802.1D.
With the aid of these virtual connections vid_11...nk each connected
subscriber has at least one logically separate communication channel
via the access network ACCESS. It should be pointed out that
10 alternatively the virtual connections vid_11...nk on the subscriber
side specific to the individual subscriber connections can also be
terminated at the relevant subscriber connection TLN11...nk.

In accordance with the invention an additional connection vid_m
individual to the communication units, virtual and designed in
15 accordance with IEEE Standards 802.1Q and 802.1D is set up via the
Ethernet EN between the control unit STGD arranged in the
decentralized module DBGL...z and the control unit STGZ arranged in
the central module ZBG, via which, within the framework of the
method in accordance with the invention, the broadcasting
20 information which has been requested or subscribed to simultaneously
by a number of subscribers TLN11...nk connected to the decentralized
module DBG1...z is transmitted in each case.

Between each subscriber TLN11...nk connected to the decentralized
module DBG1...z and the IGMP instance arranged in the central module
25 ZBG the corresponding IGMP protocol for subscriber-individual
selection of broadcasting information m_inf routed to the central
module ZBG - e.g. specific television channels - is implemented from
the multicast data stream.

The method in accordance with the invention is explained in more
detail below:

With the aid of the IGMP protocol implemented in each case at least
a part of the broadcasting information m_inf routed to the central
5   module ZBG can be selected by each subscriber TLN11...nk. To this end
the subscribers TLN11...nk signal with the aid of the IGMP protocol
their desire to be members of a corresponding "multicast group". In
accordance with the invention the data exchanged within the
framework of the IGMP protocol (here for example IGMP Join/Leave
10   Requests) is forwarded via the relevant decentralized module DBG1...z
transparently over the Ethernet EN to the central module ZBG, but
the data transmitted is read, evaluated and registered (logged) by
the control unit STGD arranged in the decentralized module DBG. This
"logging" of the information transmitted within the framework of the
15   IGMP protocol is also referred to as "IGMP snooping". The
information snooped within the framework of IGMP snooping snoop-inf
allows subscriber connections requesting specific broadcasting
information to be assigned or the virtual connections vid_11...nk
routed via these subscriber connections TLN11...nk to be assigned to
20   the relevant multicast group. The snooped information snoop-inf is
stored in a memory MEM provided in the decentralized module DBG1...z
and assigned to the control unit STGD.

The IGMP Requests mentioned are transmitted via the Ethernet EN to
the IGMP instance arranged in the central module ZBG and which
25   terminates the IGMP protocol. With the aid of the information
transmitted to the IGMP instance the virtual connection vid_11...nk
specific to the subscriber connection via which the multicast groups
or broadcasting information m_inf are requested can be determined.
This information is stored as distribution information vie for

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example in the form of a table taub(vie) in a memory MEM on the
central module ZBG.

The broadcasting information m_inf arriving within the framework of
the multicast at the input ZE of the central module ZBG is checked

5   with the aid of the distribution information vi stored in the memory
MEM within the framework of a "LookUpl. Part of the check
establishes which broadcasting information m-inf - i.e. in this
exemplary embodiment which television channel - is to be transmitted
via which virtual connection vid_11...nk to the relevant subscriber

10   TLN11...nk connected to the decentralized module DBG1...z. If the
broadcasting information m_inf arriving or a part of this
broadcasting information m_inf has been requested simultaneously by
a number of subscribers TLN11...nk connected to the communication
unit or module DBG1...z - for example if a specific television

15   channel (Sport) is requested by n-subscribers - in accordance with
the known prior art a part of the broadcasting information arriving
and representing the desired sport television channel - because the
multicast protocol is terminated in the central module ZBG - would
have to be replicated n times in the central module ZBG and the

20   broadcasting information thus replicated or duplicated forwarded via
the virtual connections vid_11...nk specific to the subscriber
connections over the Ethernet EN to the corresponding subscribers
TLN11...nk.

By contrast with this multicast solution which is to be assigned to

25   the known prior art, in accordance with the inventive method a check
is made by the control unit STGZ arranged in the central module ZBG
as to whether the broadcasting information m_inf arriving or a part
of said information is to be transmitted to a number of physical
subscribers or subscribers TLN11...nk assigned locally to a

30   decentralized module DBG1...z. If the check establishes that at least
a part of the broadcasting information m_inf arriving at the input
ZE of the central module ZBG is to be transmitted to a number

of subscribers of a module, this at least one part of the
broadcasting information m_inf arriving will be assigned a specific
Ethernet multicast MAC address and this part inserted into an
Ethernet data frame. In accordance with the invention the IP

5   multicast address of the broadcasting information m_inf involved
will be converted or "mapped" into a corresponding Ethernet
multicast address. The Ethernet data frame generated in this way
will however not be fed at the central module ZBG (after previous
replication) into the virtual connections vid_11...nk assigned to the

10   individual subscriber TLN11...nk, but will be transmitted via the
individual virtual connection vid_m for the communication unit set
up specifically for the purpose to the corresponding decentralized
module DBG1...z, or to the control unit STGD arranged within it and
which terminates the virtual connection vid_m. This Ethernet data

15   frame is thus correctly replicated at logical level, but at physical
level will only be transmitted once over the Ethernet EN via the
virtual connection vid_m provided for it. Shifting the replication
of the transferred broadcasting information which is necessary as
part of the multicast in the direction of the subscriber enables

20   transmission resources of the Ethernet EN to be saved.

With the aid of the information snoop-inf determined within the
framework of the IGMP snooping and stored in the decentralized
module DBG1...z an assignment of the Ethernet data frame received,
i.e. a mapping or conversion of the received Ethernet multicast

25   address to the corresponding addressed subscriber connections
TLN11...nk or to all the virtual connections vid_11...nk routed via
them can be undertaken. The broadcasting information to be directed
to the control unit STGD via the virtual connection vid_m (which for
example represents one or more specific television channels) is thus

30   forwarded to all subscribers, by whom (by means of an IGMP Request)
the relevant broadcasting information is requested.

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In accordance with the invention the broadcasting information m_inf received with the aid of the Ethernet data frame in the decentralized module DBG1...z will be replicated appropriately often depending on the requirements of the subscriber and the replicated

5   broadcasting information will be fed into the relevant virtual connection vid_11...nk specific to the subscriber. This is done by simply modifying the identification of the individual virtual connection vid_11...nk and feeding it back into the Ethernet switch EN-SW provided for the purpose in the decentralized module DBG1...z.

10   The broadcasting information fed in this way into the corresponding virtual connection vid_11...nk will be forwarded in the usual way to the requesting subscribers.

The advantage of the method in accordance with the invention is that the replication of the broadcasting information to be transmitted to

15   a number of local subscribers assigned to a module, i.e. the replication point, is shifted further in the direction of the subscribers and thereby the transmission resources required to cover the transmission of the broadcasting information can be used more efficiently. The replication point is shifted in this case

20   independently of the termination of the multicast protocol which is implemented in the central module ZBG. In accordance with the invention each central module ZBG has background knowledge or information about which subscribers are members of a multicast group or have requested the same broadcasting information and are

25   simultaneously physically assigned to a decentralized module. Advantageously the broadcasting information to be transmitted to these subscribers can be simply transmitted via a specific virtual connection, with replication being undertaken later at the decentralized module.

30   In accordance with a further design variant the subscribers assigned to a decentralized module DBG can be connected by means of different data transmission methods i.e. via differently designed protocol

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stacks or protocol levels - e.g. with or without PPP (Point to Point
protocol) between the IP and Ethernet protocol level. If this type
of configuration is available, in accordance with an advantageous
development of the method in accordance with the invention, for each
5   type of protocol stack implemented in a decentralized communication
unit or at a decentralized module a separate virtual connection
specific to the communication unit or module and protocol stack can
be set up for transmitting the broadcasting information between the
relevant decentralized module DBG and the central module ZBG. The
10   snooping of information described within the framework of the IGMP
data exchange both on the decentralized module side (IGMP snooping)
and also on the central module side is undertaken in a suitable way,
with additional, i.e., protocol stack-specific information being
retained and stored both in the central and also in the
15   decentralized module (vi, snoopinf).